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ARTICLE

Impact of Household Endowments on Response Capacity of Farming Households to Natural Disasters

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Abstract This article investigates the impact of household endowments on household's ability to cope with natural disaster risks and the determining factors of disaster coping capacity. We present results of a research based on household survey. The data were analyzed with an ordered Probit model regression. The project surveyed 923 rural households in 2009 and 2010 in 39 national-level poverty-stricken counties of Sichuan, Yunnan, and Guizhou Provinces and Chongqing Municipality. This research determined that the economic strength of households is the most important factor affecting their disaster coping capacity. The ability of farming households to cope with disasters is also significantly impacted by family members' experiences and their economic context at the village level. Ethnic minority areas in southwestern China are the poorest in the country and are often the main disaster-affected areas. Since household endowments significantly affect the ability of farming households to cope with disasters, integration of disaster risk management and poverty reduction is a viable way of enhancing coping capacity of farming households to natural disasters.

Keywords disaster risk, ethnic minority areas, farming households, household endowments, response ability

1 Introduction

In the past decade in China, major natural disasters primarily affected ethnic minority regions and rural areas. The Wenchuan Earthquake in 2008, the Yushu Earthquake in 2010, the Zhouqu Mudslides in 2010, and the Yiliang Earthquake in 2012 all occurred in ethnic minority areas. Natural disasters seriously hampered the economic and social development of these areas. After the Wenchuan Earthquake, the local poverty rate rose from 30 percent in the predisaster period to more than 60 percent (Xinhua News Agency 2009). Farmers and farming households were the main exposure units and key players in disaster response, but have not been given sufficient attention in disaster research and planning. The current system of disaster prevention and disaster response has focused heavily on the building of the government's disaster management capacity (Shi 2012), while the disaster response capacity of households has been largely neglected.

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Capacity to cope is increasingly seen as a key component of a household's or community's level of vulnerability (Few 2003). Success or failure of a society's response to disasters depends to a large extent on individuals' capability to cope with adverse situations. Therefore increasing households' disaster preparedness may be crucial to saving lives and mitigating damages. At the end of the 1990s, Anderson and Woodrow (1998) stressed the need to identify the capacities that already exist in societies when designing disaster-related development interventions. Since then this positive aspect has been further explored.

In his vulnerability / coping capacity analysis of a rural community's resource utilization, Guarnizo (1992) develops a framework for mapping adjustment mechanisms based on social organization, economic relationships, technology use, and cultural arrangements. The framework explores how these variables relate to different phases in the disaster life-cycle (before, during, and after). Anderson and Woodrow (1998) identified three factors—physical/material resources; social/organizational structures; and motivational/attitudinal factors that affect disaster coping capacity. Morrow (1999) sees risk as socially constructed from the following: economic and material resources that are extended to include human or personal resources (such as education); family and social resources (such as networks of reciprocity); and political resources (such as power and autonomy). It is increasingly accepted that people do not simply draw on their assets, but possess sophisticated skills in managing them to cope with adversity and take advantage of opportunities. There is a growing recognition that the poor are strategic managers of complex asset portfolios (Moser 1998). A central focus on household assets and strategies lies at the heart of the now influential livelihoods approaches to developmental research and practice. In this framework, assets mediate the ability of households to pursue livelihood strategies designed to cope with "shock" events such as flooding (Carney 1998). Lindell and Hwang (2008) confirm the importance of hazard experience, gender, and income and to a lesser extent, hazard proximity, risk information, and ethnicity in affecting perceived personal risk.

Many scholars in China have studied the behaviors of farmers in coping with risks and their strategies. Xu (2000)

has discussed the methods of farmers' financial risk management. Other researchers (Ding and Chen 2001; Chen and Ding 2003; Chen 2005, 2007; Chen, Chen, and Ding 2007) have studied farmers' predisaster risk prevention strategies and postdisaster response strategies and management measures/effects, as well as informal risk-sharing mechanisms among family and friends. Qian and Nakamoto (2008) have established a model of an agricultural business plan by linear programming, and investigated the mitigation and transfer of risks for farming households.

Research on disaster response of farmers has focused on risk coping behaviors and coping strategies. Studies specifically focusing on farming households' coping capacities are much fewer. There is a general lack of research on disaster response of farmers in ethnic minority areas. Existing studies on disaster risk management in minority areas generally approach the issue from the macro level of the government or the market. These approaches lack enough concern for farmers who actually have a very important role in disaster response. This study investigates through micro-level analysis the impact of household endowments on the response ability of farmers to disasters. The purpose is to find out the most significant factors in household endowments that affect household disaster response capacity. Equally important are the impacts of different endowments on farmers' ability to cope with risks. The research also intends to establish a baseline for future studies in farmers' response ability to disasters in ethnic minority areas.

2 Hypotheses and Modeling

2.1 Hypotheses

Enhancing farmers' coping capacity to disaster risks is an effective way to improve disaster prevention and reduction. Existing research has identified the following factors as affecting farmer's ability to deal with risks: assets (such as income, land), social interaction, family members' awareness of natural disasters, willingness to take protective actions, disaster experience, ethnicity, family structure, and aid policy, among others. Rural households are the smallest unit of production and consumption. Their endowments and the characteristics of their natural resources constitute their potential risk management capacity. At the micro-level, the coping capacity of farming households to disaster risks is mainly affected by household endowments, which refer to the natural and acquired resources and capacity owned by family members and the entire extended family (Kong et al. 2004). The factors involved include family members' health status, education background, personal experience, social networks, resources availability, and the size of the family business, its geographic location, and the larger economic environment. The hypotheses used in the research are:

Hypothesis 1: Ethnicity of the head of a household, household structure, health status, education background, experience, and other characteristics of household members have significant impact on the response capacity of farmers to disasters.
The endowment of family members is the most important resource and material basis for farmers' response ability to disasters. Better health status of family members enables them to engage in self-help and reconstruction to reduce disaster losses in the face of natural hazards; members with higher education have more knowledge of disaster prevention and better potential to actively participate in disaster risk management; well-informed members with rich experience are more likely to find alternative employment and can find more ways to seek assistance when encountering disasters. The traditions and cultures of people of different ethnicities affect the cognition and response capacity of households and their members. Here, seven indicators were selected to reflect farming households' endowments, namely ethnicity of the head of household, household structure, proportion of healthy members in the household, proportion of illiterate members in the household, number of migrant workers in the household, number of household members who are serving or have served as village cadres, and whether any household member has received skill training in the year of the survey.

Hypothesis 2: Farming households' scales of operation, geographic location, and economic conditions have impacts on the response capacity of farmers to disasters.
The economic strength of farming households is their most important capacity and directly influences their ability to cope with risks. Ding and Cook (2000) conclude that farmland is still an important means for family income and security; Chen and Ding (2003) in an empirical study on farmers' response strategy to risks found that using savings and loans and reducing expenses are the primary means for farmers to cope with large expenditures and economic difficulties. Seeking temporary employment outside of home areas is also an important way for farmers to avoid risks. The larger the scale of a farming operation, the stronger the economic strength and ability to cope with disaster risks should be. However, households with larger operations may also be exposed to greater risks precisely because of their scale of operation, and suffer from greater losses when disasters strike. Farming households living in convenient geographic locations have easier access to a variety of market and technology information, and relief may be more readily available when disasters occur, so the response capability of these farmers may be stronger. Households with better economic conditions have more savings that they can use to overcome temporary difficulties when encountering disasters. Such farmers have a better loan repayment expectation and thus a better prospect for getting loans, which should have a significant positive effect on their disaster response capacity. A total of four indicators were selected in this research to reflect these characteristics, namely a household's cultivated farmland area, the

travel time required to reach the nearest town, a household's total housing area, and net household income in the year of the survey.

Hypothesis 3: The technological environment surrounding households, economic environment, and social environment have impacts on the response capacity of farmers to disasters. Environmental endowments are important resources for farming households, and provide an important foundation for acquiring other resources and capabilities. For most native famers, the ability to choose or modify the environment surrounding them is limited, and environment endowments are one of the most important set of endowments that these households own. A good technological environment facilitates the farmer's ability to apply technology to disaster prevention and reduction of disaster losses. A healthy economic environment may offer better employment and income opportunities. A positive social environment enables farmers to receive help from their communities. In this research a total of six indicators were selected to reflect environmental factors: a skill training has been conducted in the village during the survey year, village-level per capita income, one or more village resources—hydropower, mining, and tourism, specialized village economic cooperation organizations, satisfaction level about the village cadres, and satisfaction level about the community's social environment.

2.2 The Model

Coping capacity of farmers to disaster risks is selected as the dependent variable in this research, and it is divided into five levels by the Likert scale: very weak, weak, normal, strong, very strong. Indicators representing the characteristics of households and household members, households' economic strength, and the broader socioeconomic and technological context in which those households operate are the independent variables.

As the dependent variable is an ordinal variable and the independent variables use mainly discrete data, a probability model would be suitable for modeling the relationship. The ordered Probit model has been used widely with multivariate discrete data. It is a limited dependent variable model.

As the actual observed data for y is discrete, it cannot be directly estimated with a linear model. Assuming that there exists in theory a continuous indicator y_i^* that depends on explanatory variable x, y_i^* as the unobservable variable is the mapping of y, which is in compliance with conditions of the ordinary least squares. Therefore,

$$y_i^* = \beta x_i + \varepsilon_i,\ i = 1,2,\cdots,n$$

In this equation, β represents the parameter vector, $\varepsilon_i \sim N(0, \sigma^2)$, namely, the observed samples are independent and have normal errors. The existence of boundary points μ_1, μ_2, μ_3, μ_4 is further assumed, and they are the unknown dividing points of households' response ability to the natural disasters, $0 < \mu_1 < \mu_2 < \mu_3 < \mu_4$, that is,

$$y_i = \begin{cases} 5;\ if,\ y_i^* > \mu_4 & \text{Very strong response capacity} \\ 4;\ if,\ \mu_3 < y_i^* \le \mu_4 & \text{Strong response capacity} \\ 3;\ if,\ \mu_2 < y_i^* \le \mu_3 & \text{Normal response capacity} \\ 2;\ if,\ \mu_1 < y_i^* \le \mu_2 & \text{Weak response capacity} \\ 1;\ if,\ y_i^* \le \mu_1 & \text{Very weak response capacity} \end{cases}$$

Probability of $y = 1,2,\cdots,5$ are:

$$Prob(y=1 \mid x) = Prob(y_i^* \le \mu_1 \mid x) = \Phi(\mu_1 - \beta x_i)$$
$$Prob(y=2 \mid x) = Prob(\mu_1 < y_i^* \le \mu_2 \mid x) = \Phi(\mu_2 - \beta x_i) - \Phi(\mu_1 - \beta x_i)$$
$$Prob(y=3 \mid x) = Prob(\mu_2 < y_i^* \le \mu_3 \mid x) = \Phi(\mu_3 - \beta x_i) - \Phi(\mu_2 - \beta x_i)$$
$$Prob(y=4 \mid x) = Prob(\mu_3 < y_i^* \le \mu_4 \mid x) = \Phi(\mu_4 - \beta x_i) - \Phi(\mu_3 - \beta x_i)$$
$$Prob(y=5 \mid x) = Prob(y_i^* > \mu_4 \mid x) = 1 - \Phi(\mu_4 - \beta x_i)$$

Φ is the cumulative density function of a standard normal distribution. Similar to the general Probit model, the ordered Probit model parameters are estimated with the maximum likelihood method. However, the marginal effect of the independent variable x on probability does not equal to coefficient β. As for this probability, the marginal effects of changes in the independent variables are:

$$\frac{\partial Prob(y=1)}{\partial x} = -\phi(\mu_1 - \beta x_i)\beta$$
$$\frac{\partial Prob(y=2)}{\partial x} = [\phi(\mu_1 - \beta x_i) - \phi(\mu_2 - \beta x_i)]\beta$$
$$\vdots$$
$$\frac{\partial Prob(y=5)}{\partial x} = \phi(\mu_4 - \beta x_i)\beta$$

Thus, the derivative of $Prob(y = 1)$ has an opposite sign with the coefficient β, while the derivative of $Prob(y = 5)$ has the same sign with the coefficient β, and the relationship between the derivative of $Prob(y = 2)$ and β cannot be determined, but depends on the following measurements: $\phi(\mu_1 - \beta x_i)$ and $\phi(\mu_2 - \beta x_i)$. The same applies to $Prob(y = 3)$ and $Prob(y = 4)$ (William 1998).

The basic model for this study is as follows: the coping capacity of farmers to natural disaster risks = f (Household member characteristics, economic strength of household, environment factors) + random disturbance.

3 Farming Household Survey and Econometric Estimation

3.1 Study Area

The southwest minority areas in this research refer to the ethnic minority autonomous areas in Chongqing Municipality and Sichuan, Yunnan, and Guizhou Provinces that are predominantly inhabited by ethnic minorities. The southwest minority areas are the most concentrated areas of ethnic

minorities in China, inhabited by a total of 55 ethnic groups; it is also one of the poorest areas in China. Currently nationwide there is a total of 265 minority counties designated as national key poverty-reduction counties. In Sichuan, Yunnan, Guizhou, and Chongqing there are 112 such counties, accounting for 42.3 percent of the national total and 62.92 percent of such counties in the southwest region. National key poverty-reduction counties are designated by the Chinese government in an effort to reduce poverty and promote development in areas that suffer from deep poverty. In 2010, per capita net income of farmers in the southwest minority areas was 3102 yuan, accounting for 52.4 percent of the national average. Key poverty-reduction counties in Sichuan had a poverty rate of 31.22 percent, and minority areas in Guizhou had a poverty rate of 18.52 percent. Yunnan Province, with a smaller population, had a much higher percentage (74.2%) of the population in absolute poverty or belonging to the low-income group. Ethnic minorities living in the border areas had an absolute poverty and low-income rate of 45.2 percent, while in the same year the national poverty incidence was 2.8 percent and in western regions this number was 6.1 percent (Department of Rural and Social Economic Survey, National Bureau of Statistics of China 2011; Yunnan Bureau of Statistics and Yunnan Survey Corps of National Bureau of Statistics 2011; Sichuan Bureau of Statistics and Sichuan Survey Corps of National Bureau of Statistics 2011; Guizhou Bureau of Statistics and Guizhou Survey Corps of National Bureau of Statistics 2011).

The southwest minority poor areas are largely affected by river floods and related hazards along major rivers, geological hazards in the mountain areas, and the regional ecology is very fragile. In 2010, the direct economic losses caused by natural disasters in Sichuan, Yunnan, Guizhou, and Chongqing accounted for 20 percent of the national total, and the affected population accounted for 27.5 percent of the total population affected nationwide (National Bureau of Statistics of China 2011). Recurring disasters and severe poverty in poor minority areas in the southwest exist together and reinforce the impact of each other. In the surveyed area in 2008–2010, farmers suffered the most severe natural disasters, including droughts and floods, which caused great economic losses. Due to its topography, ethnic minority areas in western Sichuan Province have a high occurrence frequency of geological disasters. In the eastern part of the province in the Yangtze River basin, flood is a serious threat. Guizhou and Yunnan Provinces, under the prevailing influence of the southwest monsoon, frequently experience seasonal drought, especially in spring.

3.2 Data Sources

Data in this study were collected from 39 priority counties of ethnic minorities in the national poverty reduction program in Sichuan, Yunnan, and Guizhou Provinces and Chongqing Municipality. The survey was conducted from December 2009 to March 2010, with county as the primary sampling unit. The 39 counties account for 34.8 percent of the priority counties of ethnic minorities in the national poverty reduction program in southwest China.

The survey includes 923 households in 160 villages of 104 towns and townships in those 39 counties. In order to ensure the survey's quality, the questionnaire was tested in advance and improved. The formal survey was administered by senior students recruited from Sichuan Agricultural University, Guizhou University, and Aba Teachers' College who were from the surveyed regions. These students were trained and passed quality control exams. They brought the questionnaires back home in the winter break. One or more villages were selected from each town, and households were sampled from each village randomly. The survey resulted in a total of 923 valid samples.

3.3 Indicators

There are many factors affecting the response ability of farmers to disasters, but the effects of household endowments on response ability are the main focus of this article. Based on previous studies and the hypotheses in this research, combined with field investigation, household endowment variables affecting the response ability of farmers to disasters are endowments of household members, household economic strength, and household environment endowments. The response ability of farmers to disasters reflects differences in the ability of farming households to cope with, buffer, resist, and recover from agricultural disasters of natural origin. Coping capacity is affected by a series of social and economic factors related to the livelihood, production, and product marketing of farming households (Xie, Yuan, and Sun 2007). In this article the response ability of farmers to disasters is mainly evaluated by the extent that natural disasters affect farming households' production and livelihood. According to the Likert scale, the extent that natural disasters affect a farming household's production and livelihood is classified into five levels: very weak, weak, normal, strong, and very strong. The response ability of farmers is also divided into very strong, strong, normal, weak, and very weak levels, which means that the stronger the extent that natural disasters affect farmers' production and livelihood, the weaker is the ability of farmers to respond to disasters. Data on the extent that natural disasters have affected farming households' production and livelihood are obtained by the questionnaire survey and the result is show in Table 1.

3.4 Descriptive Analysis of the Sample Data

The survey shows that only 12 percent of the farming households has strong response ability to natural disasters, while 26 percent has normal (average) response ability and 62 percent has weak response ability. According to our survey results, in poor minority areas farmers have weak ability to respond to

Table 1. Model variables and descriptive statistics

Variable Name	Definition	Mean	Standard Deviation
Dependent variable:			
Response ability of farmers to natural disasters (*y*)	1 = very weak; 2 = weak; 3 = normal; 4 = strong; 5 = very strong	2.336	0.965
Independent variables:			
1. Endowments of Household Members			
Ethnicity of household head is minority (NHM)	0 = no; 1 = yes	0.560	0.497
Family structure (FS):			
One couple with two children	0 = other; 1 = one couple with two children (comparison group)	0.305	0.461
One couple with one child	0 = other; 1 = one couple with one child	0.121	0.327
One couple with three children or more	0 = other; 1 = one couple with three children or more	0.185	0.389
One couple, children, and grandparent, three generations living together	0 = other; 1 = One couple, children, and grandparent living together	0.251	0.434
Without children or single-parent families	0 = other; 1 = no children or single-parent families	0.138	0.345
Proportion of healthy family members (HFM)	actual value (completely healthy family members/ total family members)	0.676	0.415
Proportion of illiterate family members (IFM)	actual value (illiterate family members/total family members)	0.220	0.282
Migrant workers in the household (MW)	the observed value	1.810	1.038
Family member as village cadres (VC)	0 = no; 1 = yes	0.107	0.309
Family member received skill training in the year of the survey (ST)	0 = no; 1 = yes	0.228	0.419
2. Household Economic Strength			
Cultivated area (CA)	actual value (ha)	0.384	0.560
Shortest travel time to nearest market (STM)	actual value (hour)	0.872	0.762
Housing area (HA)	actual value (m^2)	119.66	71.44
Household income in the year of the survey (HI)	actual value (yuan)	10,151	11,808
3. Environmental Endowments			
Village held a skill training in the year of the survey (VST)	0 = no; 1 = yes	0.271	0.445
Per capita income at village level (VPCI)	actual value (yuan)	1661	1301
Hydropower, mining, or tourism resources in the village (VR)	0 = no; 1 = yes	0.476	0.499
Specialized cooperative economic organizations in the village (VCO)	0 = no; 1 = yes	0.113	0.316
Satisfaction about the village cadres (SVC)	1 = very dissatisfied; 2 = dissatisfied; 3 = normal; 4 = satisfied; 5 = very satisfied	3.706	0.995
Satisfaction about the social environment in the community (CSE)	1 = very dissatisfied; 2 = dissatisfied; 3 = normal; 4 = satisfied; 5 = very satisfied	3.002	0.802

natural disasters. This endemic condition needs substantial improvement.

The 923 valid household survey questionnaires show that the average number of permanent residents of each household is 4.4, average household labor is 2.5, healthy people is 2.9 per household, and the number of migrant workers per household is 1.8. Their educational background is shown in Table 2. The distribution of family structure types is shown in Table 3. In the surveyed households, 3.14 percent lives in bamboo huts, 37.7 percent owns mud houses, 4.23 percent has stone-wood structure houses, 44.53 percent resides in brick-wood structure houses, and 10.4 percent uses reinforced concrete structures. According to these results, in poor minority areas, farming household members have a relatively low level of education, and their houses are mainly brick-wood and mud structures.

3.5 Model Estimates

With Stata10.0 statistical software, the data are processed by ordered Probit regression to produce the following regression coefficients and test results (Table 4). From Table 4, the log likelihood ratio statistics is –1167.99, *LR* $chi^2(n)$ is 119.702, while the significance level of log likelihood ratio test is $p = 0.000 < 0.05$, which indicates that the model fits the general description well, and that the impact direction of explanatory variables is basically in line with the hypotheses.

3.6 Discussion

According to the model structure, for explanatory variables whose coefficient is positive, an increase of the value of the variables enhances the probability of "very strong" response

Table 2. Educational background of the surveyed farmers

Educational Background	Illiterate	3 Years or Less	3–6 Years	6–9 Years	9–12 Years	12 Years or More
% of total surveyed population	23.30	14.28	20.75	23.14	9.48	9.05

ability of farmers to disasters and reduces the probability of "very weak" response ability, whereas if the coefficient is negative the effect will be the opposite. Specific analysis of each factor is as follows:

(1) Experience of household members has a relatively significant effect on the response ability of farming households.

Specifically, this refers to the number of migrant workers in a household, whether anyone from the household has served as a village cadre, and whether any member of the household has received skill training in the year of the survey. The trend is basically in line with actual observations: the larger the number of migrant workers in a household, the lower is the household's dependence on agriculture. The lower the impact of natural disasters on farmers' production and livelihood, the stronger is the response ability of farmers. If anyone in a household has served as a village cadre, the family's social resources may be more abundant than other farmers, while the family will have more coping methods to risks and possess relatively strong response ability to disasters. Compared with others, households that have members receiving training recently have a stronger response ability to disasters. Training content and method also affect farmers' ability to cope but the impact is not explored in this research. Taking the drought in southwest China from 2009 to 2010 as an example, in Zunyi County of Guizhou Province, through the government promotion of the "shallow dry nursery planting" technique, the local ethnic minority villagers adopted this method and were able to fight the drought and keep seedlings alive in the spring, and thus suffered less severe drought impact and reduced the economic losses caused by the drought.

The estimated result also indicates that minority ethnicity of household heads and health and educational background of family members have no significant effect on response ability. This is probably due to the dynamic and complex nature of natural disasters, which prohibits even the more educated or competent farmers from predicting and responding effectively to such disasters. In addition, the effects of family structure on the response ability of farmers to natural disasters are not significant, but the direction of impact can be seen from the positive or negative coefficients. Compared with the comparison group (one couple with two children), the response ability of households with one couple, children, and grandparent living together tends to be lower. In multigenerational families, the elderly members may have partially or completely lost the ability to engage in income-generating activities and illness may require extra spending. In the face of disasters, those family members also need extra protection, thus keep other family members from engaging in effective disaster response activities.

Table 3. Family structure of the surveyed households

Family Structure	Numbers of Households	% of Total surveyed Households
Single person or one couple	54	5.85
One couple with one child	112	12.13
One couple with two children	283	30.66
One couple with three children or more	171	18.53
Single person with children	42	4.55
One couple and their parents	30	3.25
One couple, children, and grandparent, three generations living together	231	25.03
Total	923	100

(2) Potential economic strength of households has a relatively significant effect in the response ability of farming households.

According to the estimated result, indicators reflecting the potential economic strength of households have a relatively significant impact on the response ability of farmers. These include the cultivated farmland area of a household, the shortest travel time to nearest town (market), the total housing area of the household, and total household income. The estimated result shows that cultivated farmland area has an extremely significant impact on the response ability of farmers to natural disasters, and the direction of impact is negative. This is in line with the research hypothesis. In ethnic minority areas, agricultural technology is often underdeveloped, so agricultural production mainly depends on the amount of arable land. Larger cultivated area means relatively more income from agriculture production, but meanwhile it could also mean that the disaster risks such farmers have to cope with are greater. Once adversely impacted by natural disasters, a large number of farmers in these areas could experience poor harvest or completely failed harvest, and this is consistent with the observation that farmers in poor minority areas could quickly fall back into poverty once stuck by natural disasters. The effect of the shortest travel time to nearest town on response ability is negative, which is also consistent with our hypothesis. The longer this time is, the more inconvenient is the transportation. In ethnic minority areas, settlements for farmers and herdsmen are scattered around the area and transportation infrastructure is poorly developed, so county seats are usually the local center of economic and cultural activities, and also the main center of trade for agricultural products. Farmers who have easier access to county seats often have more opportunities to engage in nonagricultural production. Furthermore, famers who live close to county seats have better access to some public service agencies that provide

Table 4. Ordered Probit regression results of household endowments on the response ability of farmers to disasters

Explanatory Variable	Coefficient	Z Value	P Value
1. Endowments of Household Members			
Ethnicity of household head is minority (NHM)	–0.004	–0.051	0.959
Family structure (FS):			
One couple with one child	0.016	0.135	0.892
One couple with three children or more	0.163	1.513	0.130
One couple, children and grandparent, three generations living together	–0.086	–0.878	0.380
Without children or single-parent families	0.165	1.423	0.155
Proportion of healthy family members (HFM)	–0.099	–1.089	0.276
Proportion of illiterate family members (IFM)	0.105	0.778	0.437
Migrant workers in the household (MW)	0.045	1.293	0.196
Family member as village cadres (VC)	0.305**	2.524	0.012
Family member received skill training in the year of the survey (ST)	0.096*	1.072	0.084
2. Family Economic Strength			
Cultivated area (CA)	–0.018***	–3.406	0.001
Shortest travel time to nearest market (STM)	–0.213***	–6.104	0
Housing area (HA)	0.001*	1.656	0.099
Household income in the year of the survey (HI)	0.187***	4.468	0
3. Environmental Endowments			
Village held a skill training in the year of the survey (VST)	0.013	0.139	0.889
Per capita income at village level (VPCI)	0.085***	1.568	0.003
Hydropower, mining, or tourism resources in the village (VR)	0.363***	4.540	0
Specialized cooperative economic organizations in the village (VCO)	–0.273**	–2.008	0.045
Satisfaction about the village cadres (SVC)	–0.015	–0.396	0.692
Satisfaction about the social environment in the community (CSE)	0.039	0.882	0.411
Log likelihood			–1167.99
Pseudo R^2			0.049
LR chi^2 (17)			119.702
Prob > chi^2			0.000

Note: ***,**, and * indicate there is a significant difference at 1%, 5%, and 10% confidence level respectively.

services such as market information, technological advice and repair, and medical treatment and aid, and thus have a built-in locational advantage. Total housing area of a household to some extent reflects the household's economic strength, and it is an effective performance indicator for long-term wealth accumulation. In general, farmers with larger housing areas have higher economic strength not only in the year of the survey but also in several recent years.

The estimated result shows that per capita net income of households in the year of the survey has little effect on response ability, which seems to contradict the research hypothesis. Further investigation suggests that among the sampled households those with per capita net income of less than 1196 yuan account for 76.6 percent of the total. With this level of income, farming households can only provide basic food and clothing for themselves, and there is no extra for investing in resisting natural disasters. According to the rural poverty monitoring result for ethnic minority autonomous areas by the State Ethnic Affairs Commission of the People's Republic of China (2008), by the end of 2007, rural population in absolute poverty in these areas is 7.74 million, accounting for 52.3 percent of the total rural population in absolute poverty in China. The poverty rate in this area is 6.4 percent, which is 4.8 percentage points higher than the national average. These numbers show that many farmers in ethnic minority areas are in deeper poverty, and there is a relatively large number of low-income households in these areas. When poor farming households are hit by natural disasters, their economic capacity to cope is extremely limited, and this may explain why in the estimated result the level of income has little effect on the response ability of farmers to disasters.

(3) Economic context, or economic environmental endowment, at the village level has relatively significant effect on the response ability of farming households.

From the estimated result, the three economic environment endowments (per capita income level, resources, and economic organizations at the village level) have relatively significant effects on the response ability of farmers. Having one or more of the resources (hydropower, mining, or tourism) in a village has a positive effect on the response ability of farmers. This is possibly because farmers who have access to electricity and whose village has mining and tourist resources have more off-farm employment opportunities. Nonagricultural income may be the main source of household income in such cases. Meanwhile, a stronger collective economic strength also facilitates the mitigation of natural disaster risks and improves the overall community response capacity to disasters.

A household's level of satisfaction with respect to village cadres and the social environment in the community has no

significant effect on the response ability of farmers. Investigation shows that the average satisfaction levels of the surveyed farmers with village cadres and the social environment of their communities are about 3 (medium). Nearly three quarters of the surveyed farmers in the villages have no trained technical skill, which to some extent explains why technical environment has no significant effect on a famer's response ability.

4 Conclusion and Policy Implications

Based on the household survey data, the effects of household endowments on the response ability of farmers to natural disasters are analyzed with an ordered Probit probability model in this study. The results show that the experience of family members is an important factor that affects the response ability of farmers to disasters. If a family member has served as a village cadre or received skill training, the response ability of the household tends to be higher. This result is consistent with our research hypothesis. Nonagricultural employment also contributes positively to enhancing households' response ability to disasters. Family economic strength is the key to the response capacity of farmers to disasters. Households cultivating larger areas of farmland are exposed to greater risks of agricultural disasters and their response ability is often low due to their heavy reliance on primitive agricultural technology. Families living closer to large towns and cities have stronger ability to respond to disasters. Those with larger housing areas have stronger economic strength, and their response ability to disasters is also higher. Economic context has a great impact on the response ability of farmers. Higher per capita income, resources, and cooperative economic organizations at the village level all have significant positive effects, which indicates that a good economic environment helps farmers by enhancing their response ability to disasters.

We believe that these findings have some potentially important policy implications. Combining disaster risk management and poverty reduction is a viable way to enhance farmers' disaster response capacity. Farmers' skill training efforts should be strengthened, especially agricultural skill training with a disaster prevention focus. Meanwhile, the skill training of migrant workers for nonagricultural employment should be increased, and policy assistance should be provided to potential job seekers. This strategy would increase the opportunity of finding off-farm employment for these farmers and eventually transfer the rural population in these areas into local towns and cities.

A second policy option is to provide increased technical and financial support to large-scale farmers in these areas. Technological advice for famers engaged in agriculture for a long time, especially the large-scale ones, should be strengthened to improve the quality of agricultural products and their marketing. At the same time, for farmers managing large areas of farmland, financial support should be provided to encourage their participation in agricultural insurance programs and thus enhance their capacity to cope with disaster risks.

Increasing rural communities' collective economic strength is another important way to facilitate the building of disaster risk coping capacity of farmers in ethnic minority areas. Regional resources should be sustainably developed by economic organizations at the village level and larger industries to increase local income. Investment in the development of communication, transportation, health, education, and other infrastructure should be enhanced. In policy and system design, individuals and enterprises should be encouraged to invest in the development of local hydropower, mining, and tourist resources as well as the production of special agricultural products. Meanwhile, the sustainable development and protection of these resources should be emphasized. Through the development of local economies with unique ethnic characteristics, the construction of specialized cooperative economic organizations, and the sharing of disaster risk burdens through such organizations, disaster risk coping capacity in rural ethnic minority areas can be improved.

Although the result of this research is supported by other similar studies, the conclusion drawn from this research is limited to the case study area since China's agricultural economy is complex and agricultural disaster risks have very large spatial variations. Any generalization of the relationships described herein warrants great caution.

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